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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Liquid Mixing Apparatus

We, ROGOR STRANGE WADDINGTON, a British Subject, of 6, Magdalene House, Manor Fields, Putney, London, S.W.15, formerly of The Hayloft, 71, Dorking Road, Epsom, Surrey, and BRUCE DUVAL, a British Subject, of 39, Cheam Road, Ewell, Surrey, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to liquid mixing apparatus of the kind which is designed to be mounted upon a water tap and which operates by using the fall in pressure on the water as it passes through the apparatus to draw in a secondary liquid, for example a detergent.

It is often desirable to control the flow of the secondary liquid in such a manner that the flow can be stopped and started when required, and when started is readily brought with accuracy to a predetermined rate which is itself adjustable. In this way primary liquid free from secondary liquid, or a mixture of predetermined concentration may be obtained as required and suitable arrangements have been described in the specifications of our co-pending Applications Nos. 6084/56 (805,046) and 6085/56 (858,653). These arrangements employ a valve member, for example a piston, which co-operates with a port in a valve chamber. The function of stopping and starting the flow and the function of adjusting it to the required rate are both fulfilled by appropriately moving the valve member preferably by means of a cam arrangement, to and from an adjustable position at which the port is uncovered to the extent which corresponds with the flow rate required. Although satisfactory results are obtainable, such arrangements tend to be bulky in practice and, unless expensive forms of construction are adopted, to wander in their adjustment.

The present invention provides apparatus of the kind aforesaid for mixing liquids, said apparatus being provided with separate flow control components for the two functions referred to above. In a preferred form of the apparatus, there is provided a valve chamber provided with a pair of ports, through one of which the secondary liquid may be led into the chamber and through the other of which it may be drawn from the chamber into the venturi, and also provided with means for controlling the flow of secondary liquid between said pair of ports, said means comprising a rotatably mounted or other movable valve member formed with a fluid passageway to provide a degree of communication between the ports which is variable by moving the valve member, and fluid flow regulating means within said passageway.

In a preferred arrangement for use where the ports are provided one in the side and the other in one end (which may be termed the inner end) of a valve chamber, the movable member is rotatably mounted in a liner for the valve chamber, and the fluid passageway is formed axially through the valve member and communicates on the one hand with the interior of the liner via an inlet aperture, and on the other hand with the end of the movable member via an outlet aperture which is so formed that it may be rotated into and out of communication with the port in the end of the valve chamber. Conveniently the fluid flow regulating means is a rod which cooperates with the outlet aperture.

A spring is advantageously provided within the valve chamber for holding the movable member in contact with the inner end of the valve chamber. This spring preferably bears upon an abutment positioned outwardly of both the port in the side of the chamber and the inlet aperture of the valve member, a sealing gland being provided in such a position that the abutment lies outwardly therefrom whilst the said port and inlet aperture

lie inwardly therefrom; with this form of construction, the spring is maintained out of contact with fluid passed into the valve member and is not therefore subject to corrosive attack thereby.

The following description of preferred embodiments of the invention in which reference is made to the drawing accompanying the provisional specification (in which the figures are numbered 1 to 3) and to the accompanying drawing (in which the figure is numbered 4) is given in order to illustrate the invention. In the drawing:—

Figure 1 is a longitudinal cross-section of a component part of a first embodiment of a mixing apparatus, said part having a valve chamber for accommodating flow control means in accordance with the invention.

Fig. 2 is a bottom view of the part shown in Fig. 1.

Fig. 3 is a longitudinal cross-section showing the valve chamber on a larger scale than in Fig. 1 and with the flow control means accommodated therein, and

Fig. 4 is a longitudinal cross-section taken through the valve chamber portion of a second embodiment of the invention.

The part shown in Fig. 1 is a hard rubber moulding which is formed at its upper end with a wide bore to provide a compartment 1, the lower portion of which can accommodate a non-return valve while the walls of its upper portion are fitted over a water tap. Leading from the compartment 1 to the lower end of the moulding is a venturi passageway constituted by a convergent inlet section 2, a parallel throat section 3 and a divergent outlet section 4. On one side of the moulding there is provided a cylindrical valve chamber 5 which communicates with the throat section 3 via a small port 6 which is displaced from the longitudinal axis of the valve chamber 5.

On the opposite side from the valve chamber the moulding is provided with a boss 7 from the outer end of which is formed a bore 8. This bore, which communicates with a short bore 9 terminating in a port 10 formed in the wall of the valve chamber, serves as a passageway for a detergent or other secondary liquid, a source of which may be connected with the boss 7.

The true position of the port 10 in the wall of the valve chamber is shown in Fig. 2. In Fig. 3 it is shown displaced by 90° for simplicity of illustration.

The inlet section 2 of the venturi passageway has an axial length of 3/8" and an angle of convergence (half-conical angle) of 12-1/2°. The throat section has a diameter of 3/16" and a length of 1", the outlet section has a length of 1-5/16" and an angle of divergence (half-conical angle) of 2-1/2° and the port 6 is 7/64" in diameter and is positioned 1/2" from the entrance to the throat section. As shown in the specifications of our co-pending Applications 6084/56 (805,046) and 6085/56 (858,653), these are relationships which ensure that the concentration of the mixture is substantially independent of the rate of flow of the primary liquid and that the apparatus exerts sufficient pumping effect on the secondary liquid even when installed in unfavourable situations e.g. where the primary liquid is supplied at a head of only 7 feet and the secondary liquid must be raised by as much as 5 feet.

Within the valve chamber is force-fitted a liner 11 moulded from polymethyl methacrylate or other rigid material. On its outer surface the liner is formed at the level of the port 10 with a circumferential groove 12 from the bottom of which a hole 13 leads to the interior of the liner. The function of the groove 12 is to enable the secondary liquid to reach the interior of the liner even if the liner is inserted with the hole 13 radially displaced from the port 10.

At its outer end, the liner is partially closed to locate a rotatable, axially bored, valve member 14. Together the valve member 14 and the liner, define an annular space 15 which is sealed against outward leakage by a rubber ring 16 located by a groove in the partially closed end of the liner. An inlet aperture 17 enables the secondary liquid to enter the bore of the valve member. At its inner end, the valve member terminates in an integral disc portion 18 which is pressed against the bottom wall 19 of the valve chamber by a stainless steel spring 20. The centre of the disc portion 18 is formed with an outlet aperture 21 whose diameter is substantially less than that of the adjacent part of the bore in the valve member. A shallow slot 21*a* leading radially from the inner end of the outlet aperture 21, provides communication with the port 6 when the valve member is rotated into the position shown in Fig. 3 by means of a handle 22 movable between stops 23 and 24 formed integrally on the moulding. By orienting the handle 22 so that when slot 21*a* and port 6 coincide it is placed in one of the extreme positions provided by the stops a very convenient on-off control for the secondary liquid is obtained. Moreover when the handle is set so that the secondary liquid is cut off, the only residual pocket of secondary liquid which is accessible to the primary liquid is the very small pocket contained in the port 6; in consequence the device can be used to deliver primary liquid, virtually uncontaminated with secondary liquid immediately after being used to deliver the liquids in admixture.

For regulating the flow of secondary liquid between the ports 6 and 10, the valve member 14 is provided internally with a regulating rod 24 carried in screw-threaded and therefore axially adjustable, relationship with a

brass bush 25 which is force-fitted in the outer end of the valve member. A nylon bush 26 force-fitted in a recess formed in the inner end of the bush 25 serves to secure the rod 24 against creep in its axial adjustment and also to maintain fluid tightness. At its outer end 27, which lies within an aperture 28 provided at the centre of the handle 22, the rod is slotted or otherwise shaped to facilitate axial adjustment thereof by a complementary tool inserted through the aperture 28. By this arrangement, the concentration of secondary liquid given by the apparatus when the handle 22 is turned to the fully on position can be set to the desired value and, when set, is maintained substantially constant over a long period of use. Furthermore, as it is found in practice, that the relationship between concentration and the distance between the inner end of the rod 24 and the seating provided by the outer end of the aperture 21 is reasonably linear over the range of concentrations of greatest interest, setting the concentration is a very simple matter.

If desired, the inner end of the liner 11 may be provided with an end plate which is formed with an aperture overlying the port 6 and which serves to protect the wall 19 from wear. This complication is however usually unnecessary.

It is to be noted that the principal functions of the liner 14 are to provide a bearing for the valve member and to provide the whole valve assembly with a surface form which enables it to be force-fitted into the chamber 5 after assembly as a separate unit. As will be appreciated the liner may be omitted and the valve member carried in a simple cover for the outer end of the valve chamber, an arrangement which is convenient when the valve chamber is formed in a metal or other rigid material for example a moulded resinous material.

The second embodiment is similar to that described with reference to Figures 1 to 3 but has its flow control means modified, as shown in Figure 4 in order to maintain the spring 20 out of contact with the secondary liquid. In this embodiment a liner 411 similar to the liner 11 houses a rotatable valve member 414 shaped as shown to provide an abutment surface 415 for the spring. A sealing ring 416, formed of elastomeric material and located in a groove formed circumferentially round the valve member at a position between the abutment surface 415 and a groove 417, which registers with the hole 13 formed through the liner and from which an inlet port 418 leads to the interior of the valve member, isolates the spring from the secondary liquid. For regulating the flow of secondary liquid the valve member is provided internally with a regulating rod 419 provided with a sealing ring 420. Adjustment of the axial position of this rod is obtained by the action of the fine screw threads, formed on the rod and on the inner surface of the valve member, when the valve member is rotated by a key (not shown) fitted into a slot 422 provided at the outer end of the rod.

Operation of the flow regulating means to stop or start the flow of secondary liquid is obtained by rotating the valve member 414, for which purpose the outwardly projecting portion thereof may be provided with a convenient handle, a particularly neat form of handle being a knob having a skirt portion which projects inwardly over the exterior of the valve chamber.

With an apparatus as shown in the drawings there is sometimes a tendency for the behaviour to be unstable when the rate of flow of the primary liquid is very high. This difficulty may be overcome by providing, in or before the convergent entrance section, a deflector plate or other convenient device adapted to promote turbulence in the throat section.

The foregoing detailed description of preferred constructions is given merely by way of illustration and is not to be taken as limiting the scope of the invention. This will especially be appreciated when it is recognised that the flow regulating means contained within the valve member may be constructed to provide a rapid on-off function while the valve member may be constructed to provide an adjustment function, i.e. that the arrangement may be the reverse of that described in detail herein.

In order to ensure that a mixing device of the type with which this invention is concerned shall give the most nearly constant concentration of secondary liquid in the mixture, arrangements may be made to ensure that the effective head through which the secondary liquid is drawn remains constant, and where the source of secondary liquid is a container, this is conveniently achieved by arranging that the level at which the secondary liquid is drawn therefrom is maintained at a constant pressure.

We have described in the specification of our Application No. 3287/57 (887,211), a can closure assembly incorporating a reciprocable tap which enables a liquid to be withdrawn from a closed container whilst air flows backwards through the tap into the container and it has been found advantageous to provide the mixing device in such form that it may be connected with a tap of this or analogous type as its source of the secondary liquid. For example, the mixing device may be provided with a pair of flexible tubes, one of which is a secondary liquid supply tube connected to the secondary liquid inlet of the device, and the other of which is an open-ended air-reflux tube. The tubes terminate in a rubber plug dimensioned to fit the liquid outlet of the tap and having an integral strap

provided with a clasp by which it may be joined around the tap and thus secure the plug firmly in position.

A short probe on the inner end of the plug serves for drawing the liquid from within the tap and passing it via a non-return valve, housed within the plug, to the supply tube. Air to replace the liquid enters the tap from the reflux tube via a bore which terminates at the inner end of the plug. The inner end of the plug is thus maintained substantially at atmospheric pressure and the pressure at the end of the probe is substantially constant.

The strap aforesaid is made sufficiently wide to cover the normal air inlet of the tap and prevent leakage therethrough. Finally, a handle provided for pulling the tap outwardly is formed with a projection which acts as a cam for locking the push-button of the tap in the continuous delivery position.

WHAT WE CLAIM IS:—

1. A liquid mixing apparatus of the kind aforesaid, said apparatus being provided with a flow control component for stopping and starting the flow of the secondary liquid and with a separate flow control component for adjusting the rate of flow of the secondary liquid.

2. A liquid mixing apparatus of the kind aforesaid having flow control means for the secondary liquid which comprises a valve chamber having a liquid entrance port and a liquid exit port, a movable valve member formed with a fluid passageway which provides a degree of communication between the ports which is variable by moving the valve member, and fluid flow regulating means within said passageway.

3. Apparatus according to Claim 2 in which the valve member is rotatably mounted.

4. Apparatus according to Claim 2 in which the ports are provided one in the side of and the other in one end of the valve chamber, the valve chamber has a liner within which the valve member is rotatably mounted and the fluid passageway is formed axially through the valve member and communicates, on the one hand, with the interior of the liner via an inlet aperture, and, on the other hand, with the end of the movable member via an outlet aperture which is so positioned that it may be rotated into and out of communication with the port in the end of the valve chamber.

5. Apparatus according to Claim 4 in which the fluid flow regulating means is a rod which co-operates with the outlet aperture.

6. Apparatus according to either of Claims 4 or 5 in which the valve member is held in contact with the end of the valve chamber by a spring.

7. Apparatus according to Claim 6 in which the spring bears upon an abutment positioned outwardly of both the port in the side of the chamber and the inlet aperture of the valve member and a sealing gland is provided in such a position that the abutment lies outwardly therefrom whilst the port and the inlet aperture lie inwardly therefrom.

8. Apparatus for mixing liquid substantially as hereinbefore described with reference to the drawing accompanying the provisional specification.

9. Apparatus for mixing liquids substantially as hereinbefore described with reference to the accompanying drawing.

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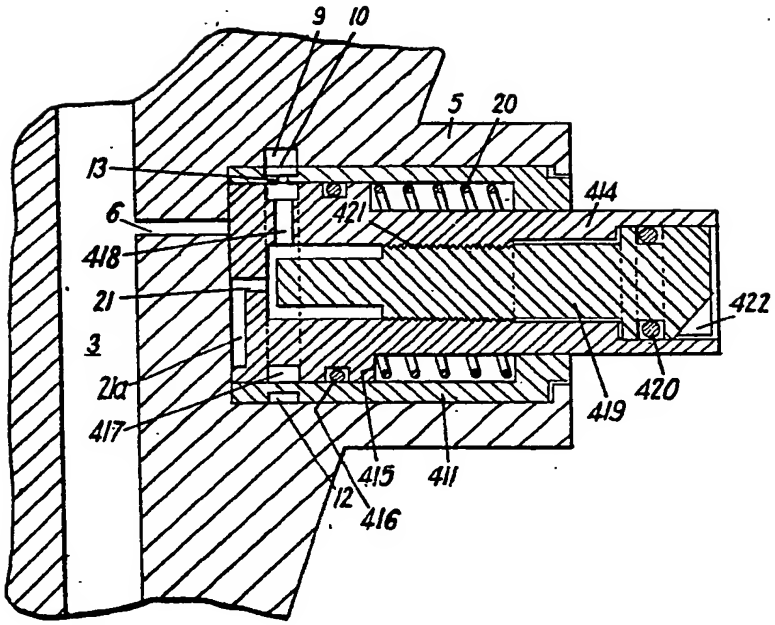
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig.4.



914801 **PROVISIONAL SPECIFICATION**

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

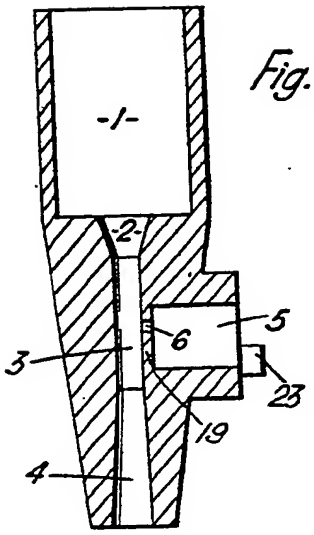


Fig.1.

Fig.2.

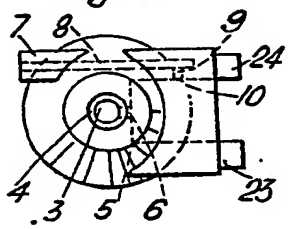


Fig.3.